

AperTO - Archivio Istituzionale Open Access dell'Università di Torino

**Adherence to European Society for Cataract and Refractive Surgery recommendations among Italian cataract surgeons: a survey.**

**This is the author's manuscript**

*Original Citation:*

*Availability:*

This version is available <http://hdl.handle.net/2318/1588581> since 2016-11-22T15:49:05Z

*Published version:*

DOI:10.5301/ejo.5000738

*Terms of use:*

Open Access

Anyone can freely access the full text of works made available as "Open Access". Works made available under a Creative Commons license can be used according to the terms and conditions of said license. Use of all other works requires consent of the right holder (author or publisher) if not exempted from copyright protection by the applicable law.

(Article begins on next page)

This is the author's final version of the contribution published as:

Grosso, A; Pertile, G; Marchini, G; Scarpa, G; Ceruti, P; Prigione, G;  
Romano, Mr; Bert, F; Gili, R; Panico, C; Siliquini, R; Engelbert, M.  
Adherence to European Society for Cataract and Refractive Surgery  
recommendations among Italian cataract surgeons: a survey.. EUROPEAN  
JOURNAL OF OPHTHALMOLOGY. 26 (5) pp: 398-404.  
DOI: 10.5301/ejo.5000738

The publisher's version is available at:

<http://www.eur-j-ophthalmol.com/attach/4CFA4149-CC78-43B6-8B5A-5E7B0363715D/53854B6B-C13F-4ED0-9E00-0E661F141904>

When citing, please refer to the published version.

Link to this full text:

<http://hdl.handle.net/2318/1588581>

**Questa è la versione post-print dell'articolo "Adherence to European Society for Cataract and Refractive Surgery recommendations amongst Italian cataract surgeons: a survey" degli autori Grosso A, Pertile G, Marchini G, Scarpa G, Ceruti P, Prigione G, Romano MR, Bert F, Gili R, Panico C, Siliquini R, Engelbert M, pubblicato come Original Paper sulla rivista European Journal of Ophthalmology.**

## TITLE PAGE

**Title:** Adherence to European Society for Cataract and Refractive Surgery recommendations amongst Italian cataract surgeons: a survey

**Running title:** Adherence to ESCRS recommendations amongst Italian cataract surgeons

Andrea Grosso,<sup>1</sup> Grazia Pertile,<sup>2</sup> Giorgio Marchini,<sup>3</sup> Giuseppe Scarpa,<sup>4</sup>

Piero Ceruti,<sup>3</sup> Guido Prigione,<sup>2</sup> Mario Romano,<sup>5</sup> Fabrizio Bert,<sup>6</sup> Renata Gili,<sup>6</sup>

Claudio Panico,<sup>7</sup> Francesco G. De Rosa,<sup>8</sup> Roberta Siliquini<sup>6</sup> and Michael Engelbert<sup>9</sup>

*(in the appendix the full list of Hospitals involved in the Survey)*

### *Affiliations*

1) Centre for Macular Research and Allied Diseases, Via Roma 73 San Mauro, Italy  
and Torino Eye Hospital, Italy

2) Sacro Cuore Don Calabria Hospital, Negrar, Verona, Italy

3) Borgo Trento Hospital, University of Verona, Italy

4) Cà Foncello Hospital, Treviso, Italy

5) Federico II University, Naples Italy

6) Department of Pediatric Sciences and Public Health, University of Torino, Italy

7) Department of Ophthalmology, Torino Eye Hospital, Italy

8) Department of Internal Medicine, University of Torino, Italy

9) NYU School of Medicine and Vitreous Retina Macula Consultants of New York, P.C.

-No sources of public or private financial support

-Financial disclosure: All the Authors have no financial or proprietary interest in any material or method mentioned

Inquiries to Andrea Grosso, MD, Centre for Macular Research and Allied Diseases, Via Roma 73,  
10099 San Mauro, Italy and Torino Eye Hospital, Italy

[78andreagrosso@gmail.com](mailto:78andreagrosso@gmail.com)

## ABSTRACT

Title: Adherence to European Society for Cataract and Refractive Surgery recommendations amongst Italian cataract surgeons: a survey

Running title: Prevention of endophthalmitis after cataract surgery in Italy

PURPOSE: To survey the surgical routines with regards to prophylactic strategies in a sample of Italian Hospitals and compare these with the European Society for Cataract and Refractive Surgery (ESCRS) guidelines.

SETTING: clinical-based study.

DESIGN: questionnaire-based survey, retrospective study

METHODS: Six private and 18 public Hospitals participated to this Survey.

Patient or study population: the overall volume of cataract operations in the 24 centres in 2013 was 43553.

Intervention or Observation Procedure(s): cataract surgery

Main outcome measures: Incidence of endophthalmitis per 1000. An incidence of less than 0.13% was considered acceptable.

RESULTS: Our study provides the first Italian data on the use of intracameral antibiotics in cataract surgery, as recommended by the ESCRS. Thirteen centres (54%) used intracameral cefuroxime at the end of surgery. Of the 13 centers that used cefuroxime, 8 (62%) had an incidence of endophthalmitis less than 0.13%. Of the 7 (29%) centres that did not use intracameral cefuroxime, all had an endophthalmitis rate of greater than 0.13%. This difference was statistically significant ( $p < 0.05$ ). Among the 4 centers not included, 2 have used vancomycin, one a quinolone, and the last a combination of antibiotics. The majority of surgeons (79%) did use preoperative antibiotic eyedrops and 63% of them have recommended topical fluorquinolones but this measure was not shown protective. No differences in the incidence of post-cataract endophthalmitis between high and low-volume sites was demonstrated.

## CONCLUSIONS

Only little more than half of the centers surveyed in this study adhered to the recommendations of the ESCRS and routinely employed prophylactic intracameral cefuroxime. An incidence of endophthalmitis greater than 0.13% was encountered significantly more frequently amongst centres that did not employ intracameral cefuroxime.

## INTRODUCTION

Endophthalmitis remains one of the most challenging and devastating complications faced by the ophthalmologist.<sup>1-8</sup> Post-cataract endophthalmitis (POE) incidence ranges from 0.04% to 0.13% with differences in regional microbiological spectrum.<sup>9-16</sup>

The European Society for Cataract and Refractive Surgery (ESCRS) has recently updated its recommendations for prevention and management of post-cataract endophthalmitis.<sup>17, 18</sup> Since the routine introduction of intracameral injection of cefuroxime 6 years ago, the rate of endophthalmitis has been significantly reduced.<sup>19-25</sup> Furthermore, a commercially available formulation of cefuroxime (Aprokam<sup>®</sup>) approved for intracameral prophylaxis was introduced to the European market in 2013.

Recently, the Italian Society of Ophthalmology issued recommendations to prevent endophthalmitis following cataract surgery but left antibiotic use to the individual surgeon's discretion.<sup>26</sup>

What the “choosing wisely” paradigm in medicine would imply for perioperative prophylaxis in cataract surgery remains controversial,<sup>27</sup> because surgical settings, techniques and preferences may be different in various settings. Topical preoperative antibiotics remain popular despite the recognition that overuse and repeated exposure to topical antibiotics can lead to the emergence of bacteria that do not respond readily to available treatments. Mounting evidence suggests that ocular surface organisms are becoming more resistant to fluoroquinolones, with up to 30% of cultured ocular isolates being resistant.<sup>28-32</sup> Also, the efficacy and safety profile of intracameral cefuroxime during cataract surgery remain controversial since there are conflicting results in the literature about the additional protective effect of cefuroxime when added to the standard of care.<sup>17,18,33,34</sup>

The purpose of our study was to conduct a survey to collect data on the attitudes and methods used to prevent post-cataract endophthalmitis in a list of selected Italian hospitals and to compare practice with ESCRS guidelines and best available evidence.

## METHODS

A multiple choice questionnaire-based survey was designed to get a broad cross-section of different settings across the country: six private and 18 public Italian Hospitals participated to this Survey.

Among public hospitals, 10 were teaching hospitals. Institutional Review Board approval was obtained at the single institution for retrospective review of identified patient records.

The incidence of endophthalmitis was established from a retrospective analysis of a coding database at the respective institution (number of postoperative endophthalmitis codes/number of cataract surgery codes at that institution). An incidence of post cataract endophthalmitis of less than 0.13% was chosen as an acceptable level of endophthalmitis,<sup>35</sup> since a systematic review found an aggregate incidence of endophthalmitis occurring after cataract surgery of 0.13%.<sup>13</sup>

The purpose of the first part of the questionnaire was to collect information about the surgical routines with regards to prophylactic strategies.

The purpose of the second part of the questionnaire was to determine the incidence of endophthalmitis after cataract surgery in the year 2013 in each Hospital and to assess whether the ESCRS recommendations with regards to intracameral cefuroxime were adhered to. Furthermore, allergic or toxic reactions with intracameral cefuroxime were inquired about.

*Statistical Analysis* The results were analyzed using the StataMP11 statistical software (Stata Corp., College Station, TX, 2011). Firstly, a descriptive analysis of the centres was conducted, considering the annual cataract volume, the number of infectious endophthalmitis cases per 1000 cataracts, the geographic area and the hospital type. Results were expressed in frequencies and percentages. Endophthalmitis incidences at the various participating institutions were dichotomized as < 0.13% versus > 0.13%. A descriptive analysis of the use of perioperative antibiotics and/or intracameral antibiotics, the use of antimicrobial drugs at the end of surgery,



possible side effects and the use of postoperative antibiotics, was then carried out.

Finally, a multivariate analysis was performed in order to highlight which outcomes were related with a rate of endophthalmitis higher or less than the expected acceptable value of 0.13%. For all analyses the alpha level was set at 0.05.<sup>36</sup>

## RESULTS

Our survey mirrors the preferred practice patterns to prevent post-cataract endophthalmitis among a spectrum of private and academic settings with varying surgical volumes in 2013.

The overall volume of cataract operations in the 24 centres in 2013 was 43,553.

Centres' characteristics are shown in Table 1: 8 hospitals were public, 10 were academic and 6 private operating within the Italian National Health System. In the table we provide readers with volume of cataract operations. Eleven centres showed an incidence of post-cataract endophthalmitis lower than 0.13% and 13 centres showed an incidence higher than 0.13%.

Table 2 shows the methods used to prevent post-operative endophthalmitis. All surgeons declared to use preoperative conjunctival povidone-iodine. The use of subconjunctival antibiotics was not reported and only in two centres vancomycin was used in the infusion bottle. The majority of surgeons (79%) did use preoperative antibiotic eyedrops and 63% of them have recommended to start a perioperative topical antibiotic 3 days before the scheduled cataract surgery. Fluorquinolones were the preferred preoperative topical antibiotics for cataract surgery (ofloxacin, ciprofloxacin and levofloxacin, in order of frequency). Thirteen centres (54%) used intracameral cefuroxime at the end of surgery. Surgeons declared to have used more than one antibiotic as a post-operative prophylaxis according to local microbiological surveillance (chloramphenicol + fluoroquinolones, netilmicin + fluoroquinolones). The majority of cataract surgeons did not taper antibiotics during follow up.

Table 3 shows the association of endophthalmitis by therapy used. Thirteen centres (54%) used intracameral cefuroxime at the end of surgery. Of the 13 centers that used cefuroxime, 8 (62%) had an incidence of endophthalmitis less than 0.13%. Of the 7 (29%) centres that did not use intracameral

cefuroxime, all had an endophthalmitis rate of greater than 0.13%. This difference was statistically significant ( $p < 0.05$ ). Among the 4 centers not included, 2 have used vancomycin, one a quinolone, and the last a combination of antibiotics. In the centres where vancomycin was used the incidence of endophthalmitis was lower than 0.13% only in one. In the centre where a fluoroquinolone was used and in the centre where a combination of cefuroxime + vancomycin was used the incidence of endophthalmitis was found lower than 0.13%.

The incidence of endophthalmitis was not associated with the use of preoperative antibiotics nor with a specific molecule. Our data showed no differences in the incidence of post-cataract endophthalmitis between high and low-volume centres.

## DISCUSSION

We present information on current prophylactic antibiotic use for cataract surgery in Italy.

Despite the existence of internationally validated standardized protocols, there is heterogeneity regarding the surgeon's attitudes to prevent endophthalmitis in the real world. All surgeons agree on the use of topical 5% povidone-iodine solution to prepare the conjunctiva for three minutes before surgery and povidone-iodine for the skin. In a recent prospective clinical study it was shown that ocular surface preparation using povidone-iodine 5% alone in the absence of postinjection topical antibiotics does not promote bacterial resistance or changes in conjunctival flora.<sup>28</sup>

However, it is controversial whether preoperative antibiotics or intracameral cefuroxime play a role in the routine prophylaxis of post-cataract endophthalmitis.<sup>27-34</sup> The majority of Italian cataract surgeons use topical fluoroquinolones in the perioperative period. In our survey, the use of perioperative antibiotics does not have a protective effect. The overuse and repeated exposure to antibiotics may lead to the emergence of bacteria that do not respond readily to available treatments. Mounting evidence suggests that ocular surface organisms are becoming more resistant to fluoroquinolones,<sup>27-32</sup> with up to 30% of cultured ocular isolates being resistant. In the era of “choosing wisely” and “antimicrobial stewardship” paradigms,<sup>27</sup> the importance of appropriate

antibiotic use needs to be emphasized: according to a recent study topical antibacterial therapy was equally effective in reducing the conjunctival bacterial load whether given 1 day or 1 hour before surgery.<sup>37</sup>

Our survey provides the first Italian data on the use of intracameral antibiotics in cataract surgery. There is already strong evidence that intracameral prophylaxis with cefuroxime may be effective in lowering the incidence of endophthalmitis.<sup>17-25, 38</sup> The ESCRS has been recommending to administer cefuroxime in the anterior chamber in all cases of cataract surgery since 2007.<sup>17-19</sup> However, the additional protective role of cefuroxime over the standardized protocols is still a matter of debate. In our survey, cefuroxime does seem to have a protective effect. Given the low rate of incidence of endophthalmitis, it is difficult to demonstrate a greater efficacy of a preventive protocol that includes intracameral cefuroxime versus a prophylactic protocol that does not include cefuroxime: however, when the ESCRS guidelines are followed, 62% of centres that routinely use intracameral cefuroxime had an incidence of post-cataract endophthalmitis lower than the acceptable 0.13% and similarly acceptable rates were found significantly less frequently amongst centers that did not routinely employ intracameral cefuroxime. Nevertheless, in 5 centres that routinely used intracameral cefuroxime the incidence of post-cataract endophthalmitis was higher than 0.13%. There may have been other factors other than just intracameral antibiotics that contributed to higher endophthalmitis rates: the use of perioperative topical antibiotics (type of molecule and duration of prophylaxis), and the clinical characteristics of the patients operated. In the sample of selected hospitals included in this survey only thirteen centres (54%) used intracameral cefuroxime at the end of surgery. However, with pre-formulated cefuroxime now being readily available, the number of Italian cataract surgeons who use cefuroxime is increasing as shown in table 2. The intracameral use may have gained slow acceptance by surgeons in Italy over other ways of administration of antibiotics (subconjunctival or in the infusion bottle)<sup>9,10</sup> for technical reasons (risk of dilution errors, and bacterial contamination) and concerns about endothelial corneal toxicity.

The important clinical question is whether cefuroxime may be the antibiotic of choice to prevent post-cataract endophthalmitis. The identification of cefuroxime as ideal prophylactic antibiotic to cover the most frequent microbiological pathogens derive from the conclusion of the Endophthalmitis Vitrectomy Study (1995).<sup>38</sup> Microbiological surveillance is mandatory to understand the current role of cefuroxime. When we compare the microbiological surveillance<sup>39-44</sup>, among different studies in US and Europe, the list of germs involved is quite stable and similar with the majority of them belonging to Gram +: *coagulase-negative Staphylococci*, *Staphylococcus aureus*, *alpha-hemolytic streptococci*, and *Streptococcus pneumoniae*. Among Gram - *Pseudomonas spp*, *enterobactriaceae*, *Haemophilus influenzae*, *Moraxella*, and *Klebsiella*.

Microbiological variations in infectious agents are secondary to differences in climate (i.e fungal infections) or organization (different health systems). In a previous report of ESCRS in 2007 only Gram + germs were isolated.<sup>17</sup> A recent microbiological review<sup>35</sup> of all culture proven cases of endophthalmitis in the last 25 years at one large institution appears to support cefuroxime versus cefazolin and/or other antibiotics that have higher resistant rates. Endophthalmitis isolates have had a significant trend toward both increasing resistance to cephalosporins and Methicillin and decreasing resistance to aminoglycosides and Imipenem. On the other hand Vancomycin has been shown to be effective towards Gram + germs but ineffective towards Gram – germs. Therefore Vancomycin<sup>42</sup> should be used as second line agent, also because it is effective against resistant strains of *Staphylococcus aureus* (MRSA). As far the allergic or toxic reactions are concerned it was recently reported<sup>45</sup> that a patient developed an anaphylactic reaction several minutes after intracameral injection of cefuroxime at the end of uneventful phacoemulsification and intraocular lens implantation surgery. In our survey 50% of surgeons were concerned about toxic or allergic reactions.

Choosing wisely also is a patient specific choice. For example, elderly patients with blepharitis, poor tear film, anticipated prolonged surgery, may be more prone to infection and therefore good candidates for intracameral or preoperative antibiotics.

There is a growing debate on the definition and the inclusion of immunocompromised patients, such as those with diabetes, cancer or long term treatment with steroids, history of trauma or previous ocular surgery: it would be of clinical interest investigate whether a correlation between specific types of germs and immunodepression may be demonstrated.

Cost-effectiveness analyses are also warranted. A retrospective study carried out at University of Udine, Italy in 2013 showed that the use of commercially available intracameral antibiotics is not cost-effective in the prevention of post-cataract endophthalmitis compared to the costs of vitrectomy for endophthalmitis, given the rare occurrence of post-cataract endophthalmitis. (*Prof. P. Lanzetta and coworkers personal communication, Pordenone, Italy, September 2014*).

Strengths of our study are the enrollment of a variety of private, public, and academic settings across Italy. This is the first Italian survey on the subject to employ email interviews for data collection. The method offers advantages over postal surveys and telephone interviews, as direct dialogue between the epidemiologists (FB, RG, RS), the principal investigator (AG) and cataract surgeons (complete list reported in the appendix) allows clarification of answers, additional queries and leaves time for a better retrospective analysis. Each centre involved in the survey was totally blind regarding the participation of the other centres.

Limitations include the retrospective nature of our study. There may have been other factors than just intracameral antibiotics that contributed to lower endophthalmitis rates. Randomized controlled trials, with rare outcomes require very large sample sizes and are costly or even cost-prohibitive to conduct. Further we could not perform a Health Technology Assessment analysis given the absence of uniform data and sufficient studies. We are aware that case control studies or models should have provided more solid scientific data than a survey. A high cut point for an "acceptable" level of endophthalmitis was decided (0.13%): in a systematic review an aggregate incidence of endophthalmitis occurring after cataract surgery of 0.128% was found.<sup>13</sup> Further the cut-off decided in our survey was lower than the level found in the Cefuroxime study.<sup>17</sup> We are aware that

it would have been desirable to have a lower than reported average level of endophthalmitis: however dealing with rare clinical events the choice of lower cut point may have weakened the association.

In conclusion, when we compare the routine clinical practice in the sample of Italian hospitals enrolled in this survey with ESCRS guidelines and best available evidence, the use of cefuroxime at the end of surgery was lower than expected. Our survey shows that a greater proportion of centers that use cefuroxime have an acceptable incidence of endophthalmitis. The majority of surgeons in our survey (83%) said they would use cefuroxime if a preformulated preparation of cefuroxime for intracameral use were commercially available, according to the literature.<sup>46</sup>

We cannot recommend or discourage the use of preoperative antibiotics, since no significant association were found in our survey,: however, when it was decided to use preoperative antibiotics fluoroquinolones were chosen.

## Acknowledgments

We are grateful to Professor Ronald Gentile (Mount Sinai Hospital, NY) and Dr Eric Sigler (Ophthalmic Consultants of Long Island, Division of Retina and Vitreous, Rockville Centre, New York, NY) for their valuable comments and criticism.

We are indebted to Dr Luis Arias (Barcelona) for sharing his surgical experience with us.

## WHAT WAS KNOWN

- Although the ESCRS guidelines recommend to use cefuroxime at the end of surgery as a direct injection in the anterior chamber since 2007, its use gained slowly acceptance by the

scientific community in Italy, also correlated to the difficulties in preparing the antibiotic (risk of dilution errors, risk of bacterial contamination).

- Pre-formulated cefuroxime commercially available “on label” formulation of cefuroxime were introduced in the European market since 2013.
- However it is not clear whether the use of cefuroxime should be offered routinely to all patient undergoing cataract surgery or based on a risk assessment (local and systemic factors).

#### WHAT THIS PAPER ADDS

- Our Survey is the wider completed in Italy to collect information about the surgical routines with regards to prophylactic strategies and it is the first to report data about the use of cefuroxime in the anterior chamber in Italy.
- Our Survey shows that a greater proportion of centers that use cefuroxime have an acceptable incidence of endophthalmitis (lower than 0.13%)
- As no significant association were found in our Survey, we cannot recommend or discourage the use of preoperative antibiotics: however, when it was decided to use preoperative antibiotics fluoroquinolones were chosen.

#### Appendix

List of centres examined by Region (from North to South)

NHS: National Health System

## Piemonte

- Torino (NHS and University): Claudio Panico MD, Francesco Faraldi MD and Savino D'Amelio MD
- Borgomanero (NHS): Vito Belloli MD, Vincenzo Ferrara MD

## Lombardia

- Milano (University): Paolo Nucci MD, Edoardo Villani MD
- Brescia (University): Francesco Semeraro MD
- Milano (University): Matteo Cereda MD
- Brescia (private hospital operating with NHS): Barbara Parolini MD
- Milano (private hospital operating with NHS): Mario Romano MD

## Veneto

- Venezia (NHS): Antonella Franch MD
- Verona (University): Giorgio Marchini MD, Piero Ceruti MD
- Treviso (NHS): Giuseppe Scarpa MD
- Negrar (private hospital operating with NHS): Grazia Pertile MD, Guido Prigione MD

## Emilia Romagna

- Reggio Emilia (NHS): Luigi Fontana MD
- Ravenna (NHS): Cesare Forlini MD
- Parma (University): Nicola Ungaro MD

## Marche

- Ancona (University): Cesare Mariotti M



## Toscana

-Pisa (NHS): Stanislao Rizzo MD, Francesco Barca MD

-Pisa (University): Michele Figus MD

## Umbria

-Perugia (NHS): Tito Fiore MD

## Lazio

-Roma (NHS): Tommaso Rossi MD

## Campania

-Acerra (private hospital operating with NHS): Aldo Gelso MD

-Napoli (private hospital operating with NHS): Otello Gallo MD

- Napoli (NHS): Beniamino Mastursi MD

- Pompei (private hospital operating with NHS): Dario Furgiuele MD

## Calabria

-Catanzaro (University): Vincenzo Scorgia MD

## Sardegna

-Sassari (University): Francesco Boscia MD

## *References*

1. Simunovic MP, Rush RB, Hunyor AP, Chang AA. Endophthalmitis following intravitreal injection versus endophthalmitis following cataract surgery: clinical features, causative

- organisms and post-treatment outcomes. *Br J Ophthalmol* 2012;96:862-6.
2. Tabandeh H, Boscia F, Sborgia A, Ciraci L, Dayani P, Mariotti C, Furino C, Flynn HW Jr Endophthalmitis associated with intravitreal injections: office-based setting and operating room setting. *Retina* 2014;34:18-23.
  3. Ness T, Kern WV, Frank U, Reinhard T. Postoperative nosocomial endophthalmitis: is perioperative antibiotic prophylaxis advisable? A single centre's experience. *J Hosp Infect* 2011;78:138-42.
  4. Alexander JW, Van Sweringen H, Vanoss K, Hooker EA, Edwards MJ Surveillance of bacterial colonization in operating rooms. *Surg Infect (Larchmt)* 2013;14:345-51.
  5. Salvanet-Bouccara A, Seegmuller JL Monitoring, reporting, and preventing nosocomial infections in ophthalmology. Creation of the National Endophthalmitis Observation Database (ONDE). *J Fr Ophtalmol* 2005;28:939-43. French.
  6. Wu PC, Kuo HK, Li M, Lai IC, Fang PC, Lin SA, Shin SJ, Chen YJ, Teng MC Nosocomial postoperative endophthalmitis: a 14-year review. *Graefes Arch Clin Exp Ophthalmol* 2006;244:920-9.
  7. Cavallini GM, Campi L, De Maria M, Forlini M. Clinical risk management in eye outpatient surgery: a new surgical safety checklist for cataract surgery and intravitreal anti-VEGF injection. *Graefes Arch Clin Exp Ophthalmol* 2013;251(3):889-94.
  8. Aaberg TM Jr, Flynn HW Jr, Schiffman J, Newton J. Nosocomial acute-onset postoperative endophthalmitis survey: a 10-year review of incidence and outcomes. *Ophthalmology* 1998;105:1004–10.
  9. Gordon-Bennett P, Karas A, Flanagan D, Stephenson C, Hingorani M A survey of measures used for the prevention of postoperative endophthalmitis after cataract surgery in the United Kingdom. *Eye* 2008;22:620-7.
  10. Schmitz S, Dick HB, Krummenauer F, Pfeiffer N Endophthalmitis in cataract surgery: results of a German Survey. *Ophthalmology* 1999;106:1869- 1877.

11. Lalitha P, Rajagopalan J, Prakash K, Ramasamy K, Prajna NV, Srinivasan M Postcataract endophthalmitis in South India: incidence and outcome. *Ophthalmology* 2005;112:1884–9.
12. Miller JJ, Scott IU, Flynn HW Jr, Smiddy WE, Newton J, Miller D Acute-onset endophthalmitis after cataract surgery (2000-2004): incidence, clinical settings, and visual acuity outcomes after treatment. *Am J Ophthalmol* 2005;139:983–7.
13. Taban M, Behrens A, Newcomb RL, Nobe MI, Saedi G, Sweet PM, McDonell PJ Acute endophthalmitis following cataract surgery: a systematic review of the literature. *Arch Ophthalmol* 2005;123:613–20.
14. Cao H, Zhang L, Li L, Lo S Risk Factors for Acute Endophthalmitis following Cataract Surgery: A Systematic Review and Meta-Analysis. *PLoS ONE* 2013; 8: e71731.
15. West ES, Behrens A, McDonnell PJ, Tielsh JM, Schein OD The incidence of endophthalmitis after cataract surgery among the U.S. Medi- care population increased between 1994 and 2001. *Ophthalmology* 2005;112:1388 –94.
16. Al Mahmood AM, Al-Swailem SA, Behrens A. Clear corneal incision in cataract surgery. *Middle East Afr J Ophthalmol* 2014;21:25-31.
17. Endophthalmitis Study Group, European Society of Cataract & Refractive Surgeons. Prophylaxis of postoperative endophthalmitis following cataract surgery: results of the ESCRS multicenter study and identification of risk factors. *J Cataract Refract Surg* 2007; 33: 978-88.
18. Barry P, Cordoves L, Gradner S. ESCRS Guidelines for prevention and treatment of Endophthalmitis following cataract surgery: Data, Dilemmas and Conclusions 2013 [www.es CRS.org](http://www.es CRS.org)
19. Friling E, Lundström M, Stenevi U, Montan P. Six-year incidence of endophthalmitis after cataract surgery: Swedish national study. *J Cataract Refract Surg* 2013; 39:15-21.
20. García-Saenz MC, Arias-Puente A, Rodríguez-Caravaca G, Banuelos JB Effectiveness of intracameral cefuroxime in preventing endophthalmitis after cataract surgery: Ten year

- comparative study. J Cataract Refract Surg 2010;36:203-207.
21. Rodríguez-Caravaca G, García-Sáenz MC, Villar-del-Campo MA, Andrés –Alba Y, Arias – Puente A Incidence of endophthalmitis and impact of prophylaxis with cefuroxime on cataract surgery. J Cataract Refract Surg 2013; 39:1399 – 1403.
  22. Van der Merwe J, Mustak H, Cook C. Endophthalmitis prophylaxis with intracameral cefuroxime in South Africa. J Cataract Refract Surg 2012; 38: 2054.
  23. Shorstein NH, Winthrop KL, Herrinton LJ. Decreased postoperative endophthalmitis rate after institution of intracameral antibiotics in a Northern California eye department. J Cataract Refract Surg 2013; 39:8-14.
  24. Rahman N, Murphy CC. Impact of intracameral cefuroxime on the incidence of postoperative endophthalmitis following cataract surgery in Ireland. Ir J Med Sci 2014; May 21.
  25. Röck T, Bramkamp M, Bartz-Schmidt KU, Mutlu U, Yoruk E, Rock D, Thaler S Using intracameral cefuroxime reduces postoperative endophthalmitis rate: 5 years experience at the university eye hospital Tübingen. Klin Monbl Augenheilkd. 2014; 231:1023-8. German
  26. Italian Society of Ophthalmology for prevention and management of post-cataract endophthalmitis. April 2013 ([www.soiweb.com](http://www.soiweb.com))
  27. Parke DW 2nd, Coleman AL, Rich WL 3rd, Lum F Choosing Wisely: five ideas that physicians and patients can discuss. Ophthalmology 2013;120:443-4.
  28. Hsu J, Gerstenblith AT, Garg SJ, Vander JF Conjunctival Flora Antibiotic Resistance Patterns After Serial Intravitreal Injections Without Postinjection Topical Antibiotics Am J Ophthalmol 2014; 157: 3514-518.
  29. Dave SB, Toma HS, Kim SJ. Changes in ocular flora in eyes exposed to ophthalmic antibiotics. Ophthalmology 2013;120(5):937-41.
  30. Yin VT, Weisbrod DJ, Eng KT, Schwartz C, Kohly R, Mandelcorn E, Lam WC, Daneman N, Simor A, Kertes PJ Antibiotic resistance of ocular surface flora with repeated use of a

- topical antibiotic after intravitreal injection. *JAMA Ophthalmol* 2013;131:456-61.
31. Goldstein MH, Kowalski RP, Gordon YJ. Emerging fluoroquinolone resistance in bacterial keratitis: a 5-year review. *Ophthalmology* 1999;106(7):1313–1318.
  32. Marangon FB, Miller D, Muallem MS, Romano AC, Alfonso EC Ciprofloxacin and levofloxacin resistance among methicillinsensitive *Staphylococcus aureus* isolates from keratitis and conjunctivitis. *Am J Ophthalmol* 2004;137:453–458.
  33. Gower EW1, Lindsley K, Nanji AA, Leyngold I, McDonnel PJ Perioperative antibiotics for prevention of acute endophthalmitis after cataract surgery. *Cochrane Database Syst Rev*. 2013;7:CD006364.
  34. Rudnisky CJ, Wan D, Weis E. Antibiotic choice for the prophylaxis of post-cataract extraction endophthalmitis. *Ophthalmology*. 2014;121:835-41
  35. Gentile RC, Shukla S, Shah M, Ritterband DC, Engelbert M, Davis A, Hu DN Microbiological Spectrum and Antibiotic Sensitivity in Endophthalmitis: A 25-Year Review. *Ophthalmology*. 2014; 121:1634-42.
  36. Cohen J A power primaer *Psychol Bull* 1992; 112: 155-159.
  37. Li B, Miño de Kaspar H, Haritoglou C, Kook D, Kampik A, Sheng M, Nentwich MM. Comparison of 1-day versus 1-hour application of topical neomycin/polymyxin-B before cataract surgery. *J Cataract Refract Surg*. 2015 Apr;41(4):724-31
  38. Endophthalmitis Study Group. Results of the Endophthalmitis Vitrectomy Study. *Arch Ophthalmol* 1995;113:1479–1496.
  39. Jindal A, Pathengay A, Mithal K, Jalali S, Mathai A, Pappuru RR, Narayanan R, Chhablani J, Motukupally SR, Sharma S, Das T Microbiologic spectrum and susceptibility of isolates in acute postcataract surgery endophthalmitis: are they same as they were more than a decade ago? *Br J Ophthalmol*. 2014; 98:414-6.
  40. Recchia FM, Busbee BG, Pearlman RB, Carvalho-Recchia CA, Ho AC Changing trends in the microbiologic aspects of postcataract endophthalmitis. *Arch Ophthalmol* 2005;123:341-

6.

41. Cornut PL, Thuret G, Creuzot-Garcher C, Maurin M, Pechinot A, Bron A, Gain P, Carricajo A, Denis P, Romanet JP, Vandenesch F, Chiquet C French Institutional Endophthalmitis Study Group Relationship between baseline clinical data and microbiologic spectrum in 100 patients with acute postcataract endophthalmitis. *Retina* 2012;32:549-5.
42. Olson R, Donnenfeld E, Bucci FA Jr, Price FW, Raizman M, Solomon K, Devgan U, Trattler W, Dell S, Wallace RB, Callegan M, Brown H, Mc Donnel PJ, Conway T, Shiffman RM, Hollander DA Methicillin resistance of *Staphylococcus* species among health care and nonhealth care workers undergoing cataract surgery. *Clin Ophthalmol* 2010;4:1505-14.
43. Moloney TP, Park J Microbiological isolates and antibiotic sensitivities in culture-proven endophthalmitis: a 15-year review *Br J Ophthalmol* 2014;98:1492-1497 .
44. Nanavaty MA, Wearne MJ. Perioperative antibiotic prophylaxis during phaco-emulsification and intraocular lens implantation: national survey of smaller eye units in England. *Clin Experiment Ophthalmol* 2010;38:462-6.
45. Moisseiev E, Levinger E. Anaphylactic reaction following intracameral cefuroxime injection during cataract surgery. *Cataract Refract Surg.* 2013;39:1432-4.
46. Barry P. Adoption of intracameral antibiotic prophylaxis of endophthalmitis following cataract surgery: update on the ESCRS Endophthalmitis Study. *J Cataract Refract Surg.* 2014;40:138-42.

